

What is claimed is:

1. An RF generating system for supplying RF output power, the RF generating system comprising:

an RF power node;

a main power source electrically coupled with the RF power node, the main power source operable to supply power utilized in generation of RF output power; and

an auxiliary power source electrically coupled with the RF power node, the auxiliary power source operable to supplement the power supplied by the main power source.

2. The RF generating system of claim 1, further comprising an RF output stage electrically coupled with the main power source, the auxiliary power source and the RF power node, wherein the RF output stage is operable to generate RF output power on the RF power node as function of the power supplied by the main power source and the auxiliary power source.

3. The RF generating system of claim 2, wherein the main power source comprises a switch-mode DC power supply and the auxiliary power source comprises a linear DC power supply.

4. The RF generating system of claim 2, wherein the power supplied by the main and auxiliary power sources comprises DC power.

5. The RF generating system of claim 1, further comprising a combiner electrically coupled with the main power source, the auxiliary power source and the RF power node, wherein the combiner is operable to generate the RF output power on the RF power node as

function of power supplied by the main power source and the auxiliary power source.

5           6.     The RF generating system of claim 5, wherein the main power source is a main RF output stage comprising a switch-mode power supply, and the auxiliary power source is an auxiliary RF output stage comprising an amplitude agile power amplifier.

10           7.     The RF generating system of claim 5, wherein the power supplied by the main and auxiliary power sources comprises RF power.

15           8.     The RF generating system of claim 1, wherein the main power source supplies power as a function of an operating point of the RF generating system and the auxiliary power source supplies power as a function of a feedback signal.

20           9.     The RF generating system of claim 1, further comprising an impedance matching network and a plasma processing chamber, the impedance matching network and the plasma processing chamber electrically coupled with the RF power node.

          10.    An RF generating system for supplying RF output power, the RF generating system comprising:

                  an RF output stage;

25                   a first power supply electrically coupled with the RF output stage, the first power supply operable to supply DC power to the RF output stage; and

30                   a second power supply electrically coupled with the first power supply and the RF output stage, the DC power selectively adjustable by the second power supply.

11. The RF generating system of claim 10, wherein the frequency response capability of the first power supply is at least an order of magnitude less than the frequency response capability of the second power supply.

5 12. The RF generating system of claim 10, wherein the first power supply is operable to modulate the DC power at frequencies in a range that is at least an order of magnitude less than the frequency of the RF power.

10 13. The RF generating system of claim 10, wherein the second power supply is operable to adjust the DC power at frequencies in a range up to the frequency of the RF power.

14. The RF generating system of claim 10, wherein the first power supply is operable to supply a magnitude of DC power to the RF output stage to create a desired amplitude of RF output power.

15 15. The RF generating system of claim 10, wherein the second power supply is operable to supply a magnitude of DC power that is at least an order of magnitude less than DC power supplied by the first DC power supply.

16. The RF generating system of claim 10, wherein the first power supply is operable to modulate the DC power as a function of an RF setpoint.

25 17. The RF generating system of claim 10, wherein the second power supply is operable to adjust the DC power as a function of a feedback signal, the feedback signal indicative of stability.

30 18. The RF generating system of claim 10, wherein the RF output power is supplied to a load, the load comprising a plasma discharge.

19. The RF generating system of claim 10, wherein first power supply is a switch-mode power amplifier.

20. The RF generating system of claim 10, wherein the second power supply is a broad band power amplifier.

21. The RF generating system of claim 10, wherein the first power supply is electrically connected in series with the second power supply.

22. The RF generating system of claim 10, wherein the first power supply is electrically connected in parallel with the second power supply.

23. An RF generating system for processing plasma, the RF generating system comprising:  
an RF output stage operable to generate RF output power;  
a DC rail electrically coupled with the RF output stage;  
a switch-mode DC power supply electrically coupled with the DC rail, the switch-mode DC power supply operable as a main power supply to modulate the magnitude of DC power on the DC rail as a function of an RF setpoint; and  
a linear DC power supply electrically coupled with the DC rail, the linear DC power supply operable as an auxiliary power supply to buck and boost the DC power on the DC rail as a function of a feedback signal.

24. The RF generating system of claim 23, wherein the RF output stage comprises a switch-mode power amplifier.

25. The RF generating system of claim 23, wherein the RF setpoint comprises a desired amplitude of RF power representing an operating point of the RF generating system.

26. The RF generating system of claim 23, wherein the feedback signal is indicative of instabilities related to the plasma.

27. The RF generating system of claim 23, wherein the feedback signal is indicative of instabilities related to the RF output power.

28. The RF generating system of claim 23, wherein the switch-mode DC power supply is operable to modulate the amplitude of the RF output power at a frequency less than or equal to about 2 MHz.

29. The RF generating system of claim 23, wherein the linear DC power supply is operable to modulate the amplitude of the RF output power at frequencies beyond the bandwidth of the switch-mode DC power supply up to the frequency of the RF output power.

30. The RF generating system of claim 23, further comprising a controller, the controller operable to perform coarse control of the amplitude of the RF output power as a function of the switch-mode DC power supply.

31. The RF generating system of claim 23, further comprising a controller, the controller operable to perform fine control of the amplitude of the RF output power as a function of the linear DC power supply.

32. The RF generating system of claim 23, further comprising a sensor, the sensor operable to provide the feedback signal, wherein the feedback signal is indicative of instabilities related to a load supplied by the RF output power.

33. An RF generating system for generating RF output power to process plasma, the RF generating system comprising:

a first RF output stage;  
a second RF output stage in operable cooperation with the first RF output stage; and  
a combiner electrically coupled with the first RF output stage and the second RF output stage, the combiner operable to combine RF power supplied by the first RF output stage and the second RF output stage to generate RF output power.

34. The RF generating system of claim 33, wherein the first RF output stage comprises a switch-mode power amplifier.

35. The RF generating system of claim 33, wherein the second RF output stage comprises one of a linear power amplifier and a quasi-linear power amplifier.

36. The RF generating system of claim 33, wherein the first RF output stage is operable to provide an amplitude of RF power as a function of an RF setpoint.

37. The RF generating system of claim 33, wherein the second RF output stage is operable to adjust the RF power provided by the first RF output stage.

38. The RF generating system of claim 33, wherein the RF power supplied by the second RF output stage is added and subtracted from RF power supplied by the first RF output stage as a function of phase rotation of the RF power of the second RF output stage relative to the RF power of the first RF output stage.

39. The RF generating system of claim 33, wherein the frequency response capability of the second RF output stage is at least one order of

magnitude larger than the frequency response capability of the first RF output stage.

- 5                   40.    A method of supplying RF output power, the method comprising:
- a) generating RF output power;
  - b) coarsely controlling the RF output power as a function of
- power supplied by a main power source; and
- c) finely controlling the RF output power as a function of power
- supplied by an auxiliary power source.

- 10                   41.    The method of claim 40, further comprising:
- d) monitoring a signal from a sensor; and
  - e) performing c) as a function of the signal.

- 15                   42.    The method of claim 40, wherein b) comprises modulating the amplitude of the RF output power at frequencies at least one order of magnitude less than the frequency of the RF output power.

- 20                   43.    The method of claim 40, wherein c) comprises modulating the RF output power at frequencies up to the frequency of the RF output power.

44.    The method of claim 40, wherein b) comprises controlling to an operating point represented as an RF setpoint.

- 25                   45.    The method of claim 40, wherein c) comprises modulating the RF output power in a metastable region surrounding an operating point.

- 30                   46.    The method of claim 40, wherein b) comprises supplying power that is DC power to an RF output stage to create a desired amplitude of RF output power.

47. The method of claim 46, wherein c) comprises supplying power that is DC power to buck and boost the DC power supplied by the first power supply.

5 48. The method of claim 40, wherein b) comprises supplying power that is RF power to a combiner to create a desired amplitude of RF output power.

10 49. The method of claim 48, wherein c) comprises rotating the phase of RF power supplied by the second power supply with respect to the RF power supplied by the first power supply.

15 50. A method of supplying RF output power to process plasma, the method comprising:

- a) generating RF output power with an RF output stage; and
- b) controlling the amplitude of the RF output power with DC power supplied to the RF output stage by a first power supply in combination with a second power supply.

20 51. The method of claim 50, wherein b) comprises:  
modulating the DC power with the first power supply at frequencies at least one order of magnitude less than the frequency of the RF power; and  
modulating the DC power with the second power supply at  
25 frequencies up to the frequency of the RF output power.

30 52. The method of claim 50, further comprising controlling the magnitude of DC power supplied by the first power supply as a function of a desired amplitude of RF power.



53. The method of claim 50, further comprising controlling the magnitude of DC power supplied by the second power supply as a function of the stability of a load coupled with the RF output stage.